Automated Energy Saving System for Outdoor Automation
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Abstract:
This project reports on a system that can save electricity. Many times in public places like bus stop, railway station if no one is there the lights and fans, are unnecessarily working by means of without switching off on that time electricity wastage will occur. So, by using this system energy will be saved based on the people presence in that particular public places. Simultaneously this system will maintain the fan speed and as well as the intensity of the light by using the light dependent resistor and temperature sensor respectively. The objective of our work is to reduce the power conception by avoiding the unwanted usage of electricity in public places.

Keywords: Microcontroller-Energy saving-Sensors

I. INTRODUCTION

Electricity is one of earthshaking resources in this century. It is the major source of power for most of the country’s economic activities. Moving towards energy sustainability will require modification not only in the way energy is supplied but also in the way it is used as well. Many times we do not turn off the light or fan at the time of leaving the public places like railway station, bus stop etc., thus electricity is wasted. By raising public awareness we can reduce the wastage of electricity. But it is not enforced due to carelessness. In this case we can use outdoor automation system. Outdoor automation is the automatic or semi-automatic control and monitoring of outdoor appliance and public place features. [1] Home automation can be done by different way. Gill k. [2] developed a Zigbee-based home automation that works through a common gateway with Wi-Fi network in order to switch home appliances. Chao-lin Wu [3] established a mobile agent based integrated control architecture for home automation system. The above automation systems only for personal relaxation. When we think to save energy require an intelligent system that can perform switching in the presence of the human body. Reference [4] discussed a system that can perform switching electrical appliances in the presence of the human body by using PIR sensor. It is costly and we can use visitor counter in the place of intelligence system mentioned above. Golay Marcel J.E [5] worked on the logic of the bidirectional binary counter. This counter has many restrictions and we can follow microcontroller based bidirectional visitor counter [6] and Design of bidirectional coherent counters by Dean K.J [7]. In order to save energy Wei Yan and S.Y.R Hui built a system [8], which has a central energy saving unit that can change the input main voltage of 220v to a variable voltage within 220v to 170v., is used to control a large lighting network and dimming is used to control light intensity. Reference [9] constructed a wireless security control systems & sensor network for smoke and fire detection. They used a smoke detector device that detects smoke & issues an alarm to alert nearby people. The objective of our proposed system is to save the energy or power, used in places like a railway station, bus stand where the lighting is very essential for the people. At the same time when people are not present in the monitored area the lighting can be made off. When people come to that area, according to the LDR output lighting can be made sufficiently brighter. By using this system, we can also fine-tune the speed of the Fan depending on the outdoor temperature measured by the temperature sensor. This work can be used in various public places like railway station, waiting places where the capacity of places is limited and should not be exceeded. Automatic light and fan Controller with Visitor Counter can be used in outdoor public places. This work can also be used in our home because many times we come out of our bedroom or any other room without turning off the room light.

II. DESIGN OVERVIEW

The design demonstrates here, has 2 modules. The first module is “Visitor counter”, the second module is “Automatic light and fan controller”. The automatic light and fan controller is used to turn ON/OFF the electrical appliance. Where the LDR is used to detect day/night to control the light. While in day the light will be switched OFF and in night the light will be switched ON automatically, where the light and speed of the fan are controlled by sensors. In this design microcontroller PIC16F877A is used to control the sensor. Here 3 sensors are used, they are Temperature sensor, LDR (Light Dependent Resistor) sensor, Motion sensor. Here the motion sensor is used to detect the person to switch ON the fan automatically. It identifies the human and other living things by using body temperature. It will deduct the person who is present under the fan and rotates automatically. Then the temperature sensor is used to sense the temperature and initiates fans to rotate according to the temperature. The fan speed can vary according to the atmosphere temperature; fan speed is controlled by this temperature sensor. Here we draw on three circuits as input of a microcontroller (MCU) and two circuits as output. The input circuits are: 1) LDR (Light Dependent Resistor), 2) Temperature sensor (LM35), 3) PIR sensor. The output circuits are 1) Lamp, 2) Fan. If a person enters in the monitored area, the PIR sensor will activate and sense the person. By sensing the person, the sensor sends a signal to the micro controller. After that the LDR checks the light intensity of the monitored area, whether it is bright or dark. LDR output will settle on the ON or OFF status of the lamp. We can also regulate light intensity depending on the brightness of the monitored area. By using this system we can change the speed of Fan according to the atmospheric temperature calculated by the temperature sensor LM35,
which are connected to the microcontroller. Also to show the atmospheric temperature. This system will save power and it is comfortable for human being.

![Figure 1. Block Diagram of automated energy saving system](image)

## III. CONSTITUENT SUB MODULES

### A. LDR

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance. There are many different symbols used to indicate a LDR, one of the most commonly used symbol is shown in the figure below. The arrow indicates light falling on it.

**Working Principle of LDR**

A light dependent resistor works on the principle of photo conductivity. Photo conductivity is an optical phenomenon in which the materials conductivity is increased when light is absorbed by the material. When light falls i.e. when the photons fall on the device, the electrons in the valence band of the semiconductor material are excited to the conduction band. These photons in the incident light should have energy greater than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band. Hence when light having enough energy strikes on the device, more and more electrons are excited to the conduction band which results in large number of charge carriers. The result of this process is more and more current starts flowing through the device when the circuit is closed and hence it is said that the resistance of the device has been decreased. This is the most common working principle of LDR.

![Figure 2. Symbol of LDR](image)

### B. TEMPERATURE SENSOR

The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 thus has an advantage over linear temperature sensors calibrated in ° Kelvin, as the user is not required to subtract a large constant voltage from its output to obtain convenient Centigrade scaling. Low cost is assured by trimming and calibration at the water level. The LM35’s low output impedance, linear output, and precise inherent calibration make interfacing to readout or control circuitry especially easy. It can be used with single power supplies, or with plus and minus supplies. As it draws only 60 µA from its supply, it has very low self-heating, less than 0.1°C in still air. The LM35 is rated to operate over a −55° to +150°C temperature range, while the LM35C is rated for a −40° to +110°C range (−10° with...
improved accuracy). The LM35 series is available packaged in hermetic TO-46 transistor packages, while the LM35C, LM35CA, and LM35D are also available in the plastic TO-92 transistor package.

Figure 4. Temperature sensor (LM35)

C. PIR SENSOR
The first motion detector was invented in the early 1950s by Samuel Bango, and which was a burglar alarm. He applied the fundamentals of a radar to ultrasonic waves – a frequency to detect fire or thief and that which human beings cannot hear. Samuel motion detector is based on the principle of Doppler Effect. Nowadays, most of the motion detectors work on the principle of Samuel Bango’s detector. IR sensors and microwave sensors can detect motion by the alterations in the frequencies they emit. Motion detectors are used as security systems in banks, offices and shopping malls, and also as intruder alarm in home. The prevailing motion detectors can stop serious accidents by sensing the persons who are in close proximity to the detector. We can observe motion detectors in shopping malls or stores with automatic doors. The main element in the motion detector circuit is the dual infrared reflective sensor or any other detecting sensor. PIR sensors detect a person’s body heat when the person comes in close proximity. These sensors are small, low power, inexpensive and easy to use. Due to these reasons, PIR sensors are generally used in gadgets, home appliances, business enterprises, industries, etc. PIR gives digital output when it detects motion. It consists of pyro-electric sensor that detects the infrared radiation emitted from humans.

Figure 5. PIR sensor

IV. AUTOMATED ROOM LIGHT AND FAN CONTROLLER
The automatic light and fan controller is used to turn ON/OFF the outdoor appliance. When the number of persons within the public place is zero, light and fan stays OFF. When they are present, the light and fan made ON, where light intensity and speed of the fan are controlled by sensors. The heart of our automation system is a microcontroller, which is configured by programming in the Micro C Pro, an advanced C compiler for the PIC Microcontroller Unit. By using the following flow chart we can write the source code.

Figure 6. Circuit diagram of automatic Fan and Light controller
PIC16F877A is used as microcontroller for this work which is manufactured by Microchip Technology Inc. The microcontroller is powered with +5V through a battery (for the convenience of the work). For the functioning of the microcontroller a crystal oscillator is used. The microcontroller get input signals, LDR, temperature sensor LM35 and send output signals to the light, & fan. Regard as a particular place which is connected to our experimental kit. Light dependent resistor as the name suggests depends on light for the variation of resistance. When light falls on the narrow piece, the resistance decreases. In the deficiency of light the resistance can be 10k to 15k. Hence voltage drop across LDR also changes with the intensity of exposing light. The variable voltage of LDR is applied to the input of the MCU (pin 3, RA1), is compared with threshold voltage applied to the MCU (pin 5, RA3). When the voltage is less than the threshold voltage MCU provides 1 (high voltage) to the dimmer1 circuit which switches the light, through the output pin 13 (RC2). Light intensity can be controlled by the variable voltage drops of LDR. Here we make use of LM35 temperature sensor whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The LM35 is rated to operate over a range of -55°C to +150°C temperature range.
range. It varies 10mv of the output voltage of LM35 for the change of per degree centigrade temperature. The variable voltage of LM35 is applied to the input of the MCU (pin 2, RA0), is compared with threshold voltage applied to the MCU (pin 4, RA2). When the voltage is greater than the threshold voltage, MCU provides 1 (high voltage) to the dimmer2 circuit which switches the fan, through the output pin 12 (RC1). The speed of the fan can be controlled by the variable voltage drops of LM35. With the increase of output voltage of LM35, the speed of the fan is also increased. We bring into play an LCD display which has 14 pins, where pin 4 is connected to output pin 25 (RB4) of MCU, pin 6 to output pin 26 (RB5) of MCU, pin 11 to output pin 21 (RB0) of MCU, pin 12 to output pin 22 (RB1) of MCU, pin 13 to output pin 23 (RB2) of MCU and pin 14 of the LCD display is connected to output pin 24 (RB3) of MCU. The atmospheric temperature and the threshold temperature are shown. The light intensity and threshold intensity are shown in lines respectively. The liquid crystals can be controlled through an applied electric voltage so that light is allowed to pass or is blocked. By carefully controlling where and what wavelength (color) of light is acceptable to pass.

V. RESULT AND DISCUSSION:

The output samples of the project are provided as follows:

VI. CONCLUSION

Outdoor automation with considering Energy Saving System is not limited for any particular purpose, it can be used anywhere in a developing industry with little modifications in software coding according to the necessities. This concept can be used in many developing countries in order to save their limited power. It ensures that our work will not only be usable in the future but also provides the flexibility to adapt and extend, as needs change. In our scheme we associated all the sensors to micro controller with the wires. This can be originated with wireless such that we can put different sensors in different places. This sensor will turn on the micro controller with the signals instead of using wires. We can send this data to a distant location using mobile or internet. This system can also be applied to various loads like pressure, force and etc. by increasing the number of ports of the micro controller.

VII. REFERENCES


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